

Coastal Bioluminescence Prediction Network (BPN): An Economical Development by Supplementation of Existing Environmental Monitoring Resources

James F. Case
Marine Science Institute
University of California Santa Barbara
Santa Barbara, CA 93106-6150
Phone: (805) 893-2913 fax: (805) 893 8062 email: case@lifesci.ucsb.edu

Grant Number: N00014-02-1-0635

LONG TERM GOALS

The goals are to assess the annual cycle of coastal bioluminescence over a considerable along coast distance crossing faunal boundaries with the hope of discovering long term correlation with environmental conditions, with the effects of land-sea interactions, and an explanation of near simultaneous appearance of near annual luminescent blooms along the Central and Southern California coast.

OBJECTIVES

To insert relatively inexpensive profiling bioluminescence (BL) detectors among already existing environmental instrumentation along the Central and Southern California coast, particularly between the Santa Barbara Channel and Monterey Bay. It is hoped the work will reveal the underlying causes of luminescent blooms, the source populations and their successions centered on the blooms, their nutrient and physical basis, and the possible role of terrestrial runoff. This is a cooperative effort enlisting help from research groups engaged on long term investigations in the region, generating the hope that at modest cost a long term study can be established serving public environmental interests (red tides) and providing information useful to naval interests.

APPROACH

Funding is available for an initial set of 10 profiling bioluminescence detectors and several nutrient analyzers to complement equipment already in place. The BL profilers are MDDBP systems that will be placed near but independent of equipment placed by the cooperating research groups.

WORK COMPLETED

Organizational details have been established. The UCSB shops are constructing the MDDBPs and mooring assemblies.

RESULTS

Data are not expected until mid 2003.

IMPACT/APPLICATIONS

This project has potential for linking intensive localized oceanographic and BL predictive efforts such as are under way in Monterey Bay (AOSN-2) with other complementary activities as are marshaled in this proposal into an observational network that might test very large scale interactions of marine systems, for example across the Pt. Conception marine ecological boundary.

TRANSITIONS

None expected until mid 2003.

RELATED PROJECTS

Monterey Bay Aquarium Research Institute

Dr. Steve Haddock is the primary coordinator of a bioluminescence field program centered there. He intends to continue in Monterey Bay with a comprehensive sampling program to model and predict bioluminescence in relation to local physical and biological conditions. He will deploy bathyphotometers on local moorings, which will monitor conditions throughout the year. He will also have BPs on a vertically profiling mooring package, which can give a better representation of the distribution of bioluminescent blooms.

During seasonal cruises, MBARI researchers will also deploy bathyphotometers from ships and in autonomous underwater vehicles (AUVs). These instruments will sample bioluminescence from the near-shore environment into the center of Monterey Bay, and into offshore waters of the surrounding coastline. With this combination of assets he will be well poised to assemble a comprehensive set of bioluminescence measurements, which can be analyzed with the long-term MBARI samples of zooplankton, optics, nutrients, and chemistry. Ultimately Haddock hopes to be able to predict bioluminescence from the physical state of the environment, and have a real-time report of bioluminescence levels. This, he believes, will allow the implementation of a response driven sampling scheme and possibly a web-based coastal alert network.

California Polytechnic University San Louis Obispo – Prof. Mark Moline

The instrumentation available at the Cal Poly marine station at Avila Beach Pier will include a real-time hydrostation consisting of a CTD, Chl fluorometer, oxygen sensor, hydrocarbon fluorometer, and a spectral backscatter meter. Additional instrumentation will include a MET station and real-time measurements of downwelling irradiance, upwelling radiance, and remote sensing reflectance. Data from all of these instruments will be available real-time through a web interface and will be archived. In addition to these fixed instruments, a REMUS AUV with a MDDBP will be deployed routinely from the pier for spatial measurements of bioluminescence, fluorometry, current speed and direction and optical backscatter. One MDDBP profiler under this DURIP proposal will be provided for this site and integrated into the real-time monitoring system.

University of California at Santa Barbara

Several major long term non-DOD supported programs will cooperate with this project:

- *PISCO*

Funded by The David and Lucile Packard Foundation, the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) is a research consortium involving marine scientists from four universities along the U.S. West Coast: Oregon State University, Stanford University, University of California, Santa Barbara and University of California, Santa Cruz. PISCO scientists at these universities collaborate on integrated studies of the nearshore ecosystems of the West Coast. By conducting large-scale studies over many years at many sites, PISCO is developing a comprehensive understanding of how coastal marine ecosystems function. Involving scientists with a diverse array of specialties, PISCO takes an interdisciplinary approach to answering key research questions. A major goal of PISCO is to train students in the marine sciences and to communicate accurate scientific knowledge about coastal ecosystems to policy makers, environmental managers, the media, and the general public.

To understand the patterns of organism transport along the U.S. West Coast, PISCO conducts studies of nearshore ocean circulation. These studies employ a suite of advanced oceanographic tools including Acoustic Doppler Current Profilers (ADCPs), coastal radar (CODAR), satellite imagery, MiniBat, surface chlorophyll estimation, and physical sensors mounted on moorings.

- *LTER*

Funded by NSF, the 24 Long Term Ecological Research programs, of which this is the only coastal site on the west coast of North America, are planned to have very long periods of support. Led by Dr. Dan Reed, the UCSB LTER has recently received its first 6-year increment of funding. Its focus is on the land-ocean margin. The UCSB LTER will study the effects of oceanic and coastal watershed influences on kelp forests in the Santa Barbara Channel. Interdisciplinary studies will be coordinated among 22 UCSB researchers. These studies will determine the effects of land use patterns on the distribution and movement of nutrients, sediments, and organisms across landscapes, their transport by streams, and the effects of stream outflows and open ocean inputs on nearshore marine environments. Studies of ocean currents, waves, sediment, light, and seawater chemistry near and in the kelp beds will suggest mechanisms of dispersal of terrestrial and oceanic nutrients and organic carbon in the coastal ocean, and the effects of these inputs on the growth of kelp and plankton and ultimately the abundances of marine animals, and food web relationships.

The LTER at present has two moorings off the Santa Barbara coast and a third soon to be installed. These are fully instrumented for ocean optics and nutrient measurements. The program will cooperate in placing MDDBP moorings in their vicinity and provide assistance in collecting samples and generally share data.

- *Plumes and Blooms*

Led by Prof. David Siegel, the overall goal of the NASA-funded Plumes and Blooms program is to understand the processes which produce sediment plumes and phytoplankton blooms in the Santa Barbara Channel and their fate in the marine environment. The group makes bi-weekly cruises across the Santa Barbara Channel and collects, via Bren School resources, and analyzes satellite ocean color data, offering early imagery of blooms. At each oceanographic station, CTD, radiometric and inherent optical property profiles are taken along with water samples used for laboratory analyses. They offer to include a bioluminescence sensor on their CTD/rosette system and to collect water samples for the bioluminescence program.